

## Tenkiller Ferry Lake

Tenkiller Ferry Lake was sampled for four quarters, from October 2001 through July 2002. Water quality samples were collected at seven (7) sites to represent the riverine, transitional, and lacustrine zones of the lake as well as major arms. Samples were collected at the lake surface at all sites and 0.5 meters from the lake bottom at sample site 1. The lake-wide annual turbidity value was 10 NTU (Plate 52), true color was 23 units, and secchi disk depth was 107 centimeters. Based on these three parameters, Tenkiller Ferry Lake had excellent water clarity when compared to other Oklahoma lakes. A trophic state index (TSI), using Carlson's TSI (chlorophyll-*a*), was calculated using values collected at all sites for four quarters (n=28). The average TSI was 56 (Plate 52), classifying the lake as eutrophic, indicative of high levels of primary productivity and nutrients. TSI values varied from season to season and from site to site. Closer to the dam area TSI values were generally mesotrophic in the fall and winter, bordering on eutrophic in the spring and summer. As you moved up the lake values were generally eutrophic in the fall, mesotrophic in the winter and eutrophic to hypereutrophic in the spring and summer. At the upper end of the lake TSI values were generally eutrophic or hypereutrophic year round (see Figure 103). All turbidity values were well below the Oklahoma Water Quality Standard (OWQS) of 25 NTU with the exception of site 5 in the fall which was 26 NTU (see Figure 104a). According to the Use Support Assessment Protocols (USAP) outlined in the Oklahoma Administrative Code (OAC) 785:46-15-5, a beneficial use is considered not supported if ≥25% of the samples exceed the screening level prescribed in the OWQS (25 NTU for turbidity). If 10% to 25% of the turbidity values exceed the numeric criteria of 25 NTU, the lake should be listed as partially supporting beneficial uses. Tenkiller Lake is fully supporting its Fish & Wildlife Propagation (FWP) beneficial use as it relates to turbidity. Seasonal true color values are displayed in Figure 104b. All of the true color values were well below the numeric criteria of 70 units and the Aesthetics beneficial use is considered fully supported.

Vertical profiles for dissolved oxygen, pH, temperature, specific conductance, oxidation-reduction potential, and salinity were recorded at all seven sample sites. Salinity values ranged from 0.02 parts per thousand (ppt) to 0.13 ppt, indicating low to moderate salt content compared to most Oklahoma lakes. Salinity values varied based on the site location with higher salinity occurring in the upper end of the lake. Specific conductance ranged from 119.1 mS/cm in the spring quarter to 277.3 mS/cm in the summer, indicating minimal to moderate levels of electrical conducting compounds (salts) were present in the lake system. In general, pH values were neutral to slightly alkaline, ranging from 6.84 to 8.58 units. According to USAP (OAC 785:46-15-5), pH values are exceeding standards if they fall outside the 6.5 to 9.0 range for 25% of the values and should be listed as not supporting beneficial uses. If 10 to 25% of the pH values fall outside the 6.5 to 9.0 range, the lake should be listed as partially supporting beneficial uses. All pH values were within the acceptable range so Lake Tenkiller is fully supporting its FWP beneficial use based on pH. Oxidation-reduction potentials (redox) ranged from 81

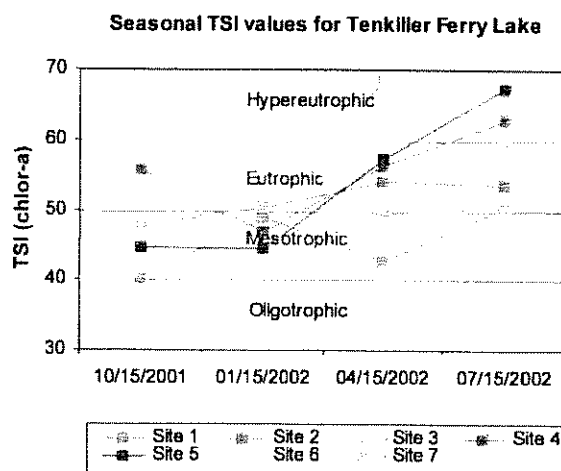


Figure 103. TSI values for Tenkiller Ferry Lake.

mV at the sediment-water interface in the summer quarter at site 1 to 614 mV in the winter. Redox readings indicated that reducing conditions were not present in the reservoir to any appreciable degree at any point during Water Resources Board sampling events. The lake was not thermally stratified in the winter or spring quarters and dissolved oxygen (D.O.) concentration fell below 4.2 mg/L throughout the water column and readings were generally above 6.0 mg/L in the majority of the water column (see Figure 104d-Figure 112e). The lake was thermally stratified in the fall quarter between 21 and 22 meters below the lake surface and D.O. values were below 2.0 mg/L from the 22 meter depth to the lake bottom at 31.5 meters at site 1 (see Figure 104d). In the summer, the lake was strongly thermally stratified at several discrete 1-meter intervals, the first between 6 and 7 meters with the water temperature dropping from 29.11° Celsius at 6 meters to 21.9° Celsius at 11 meters. From the 8-meter depth to the lake bottom at 38.4 meters D.O. values were all less than 2.0 mg/L (see Figure 104f). If D.O. values are less than 2.0 mg/L for greater than 70% of the lake volume, the FWP beneficial use is deemed not supported (OAC 785:46-15-5). If D.O. concentrations are less than 2.0 mg/L for 50 to 70% of the water column, the FWP beneficial use is deemed partially supported. According to USAP, the FWP beneficial use is considered not supported at Tenkiller Ferry Lake as 80% of the water column was anoxic in the summer. In the fall quarter 30% of the water column was anoxic which was not sufficient to result in a partially supporting or not supporting designation. The lake was sampled for total dissolved solids, chlorides and sulfates to assess its Agriculture beneficial use. Sampling in 2001-2002 found the Agriculture beneficial use to be fully supported based on numerical criteria located in OAC 785:45 – Appendix F.

Collected water samples were analyzed for nutrients, including total nitrogen and total phosphorus, although there are currently no numerical OWQS for these parameters. The lake-wide total nitrogen (TN) average for sample year 2001-2002 was 1.28 mg/L at the lake surface, which is a very high value to have as a lake average. The TN at the surface ranged from 0.47 mg/L to 2.91 mg/L, which is a very high nitrogen concentration to have in a lake at the surface. The highest value was in the winter quarter and the lowest value was in the fall. The lake-wide total phosphorus (TP) average for sample year 2001-2002 was 0.063 mg/L at the lake surface. The surface TP ranged from 0.006 mg/L to 0.156 mg/L. The highest surface TP value was reported in the fall and the lowest was also reported in the fall quarter. The nitrogen to phosphorus ratio (TN: TP) was approximately 20:1 for sample year 2001-2002. This value is greater than 7:1, characterizing the lake as phosphorus-limited (Wetzel, 1983).

Tenkiller Ferry Lake was also sampled for metals at seven sites during the spring quarter in 2002. Use support assessment for metals is made in the same fashion as turbidity and true color. Results of metals sampling showed the lake to be fully supporting its FWP beneficial use and Public and Private Water Supply (PPWS) beneficial use based on metal (toxic) compounds in the water column. The Oklahoma Department of Environmental Quality (ODEQ) sampled the lake in 1999 as part of their Toxics Monitoring Program and detected no compounds at the ODEQ screening level or consumption advisory level. The lake is fully supporting its Fish Consumption beneficial use.

In summary, Tenkiller Ferry Lake was classified as eutrophic, indicative of high primary productivity and nutrient levels (Plate 52). Water clarity was excellent at this lake primarily due to the absence of inorganic turbidity levels that are commonly seen in Oklahoma reservoirs. The lake was fully supporting its Aesthetics beneficial use based on trophic status and true color values. A Total Maximum Daily Load (TMDL) is currently being developed for the lake to mitigate the effects of nutrients to the system. A high level of total nitrogen in the lake was documented which should be mitigated. Tenkiller Ferry Lake was supporting its FWP beneficial use based on nephelometric turbidity and pH. The lake was not supporting its FWP beneficial

use based on low D.O. concentrations in 80% of the water column. The very low D.O. values seen in the summer time in the lake are a cause for serious concern. Any time 80% of the water column has D.O. less than 2.0 mg/L you have a serious problem that should be further addressed. The United States Army Corps of Engineers constructed Tenkiller Ferry Lake in 1953. The lake was authorized to serve for flood control and hydroelectric power. Today the lake serves many other purposes and is one of the most heavily used recreational lakes in Oklahoma. Tenkiller Ferry Lake is one of the lake jewels of Oklahoma and it should be managed and maintained in that fashion.



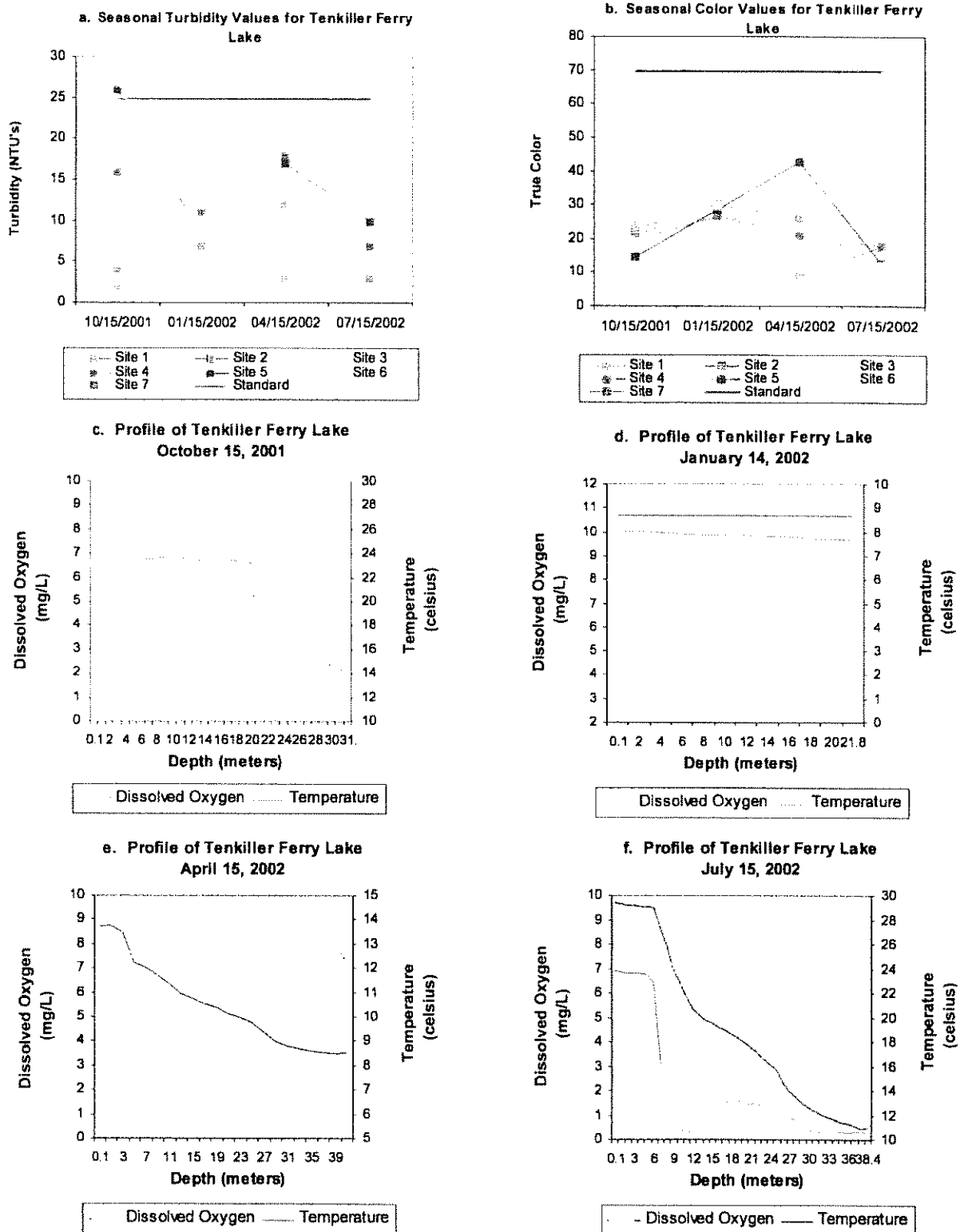


Figure 104a-112f. Graphical representation of data results for Tenkiller Ferry Lake.